

## Research Article

# Production Efficiency of Cocoon Shell of Silkworm, *Bombyx mori* L. (Bombycidae: Lepidoptera), as an Index for Evaluating the Nutritive Value of Mulberry, *Morus* sp. (Moraceae), Varieties

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The nutritional efficiency of mulberry leaves consumed by silkworms, *Bombyx mori* L., is usually evaluated in terms of the proportion of cocoon shell weight to the amount of food ingested. The production efficiency of cocoon shell is generally used to identify the superiority of a mulberry variety for silkworm rearing. In this study the production efficiency of cocoon shell was used as an index for evaluating the nutritive value of different mulberry varieties of India. Among the varieties, V-1, having highest production efficiency of cocoon shell with less amount of food ingested and highest digestibility, is regarded as the best suitable variety with nutritive values ideal for silkworm rearing.

## 1. Introduction

The silkworm, *Bombyx mori* L., consumes leaves of different mulberry varieties but the success of cocoon production depends on the efficient utilization and conversion of food to silk substance. Generally, the judgment is made from the rearing performance of silkworm on a mulberry variety emphasizing particularly the cocoon characters. But the drawback of such evaluation system is that it is very difficult to reach a conclusion on the basis of evaluation of each individual character separately. Nutritional efficiency of the food ingested by silkworms is usually evaluated in terms of the proportion of cocoon shell weight to the amount of food ingested, that is, Production Efficiency of Cocoon Shell (PECS). The production efficiency of cocoon shell is generally used to identify the superiority of a mulberry variety for silkworm rearing. Extensive studies have been undertaken for many years [1] indicating that PECS is a final indicator for the evaluation of nutritive values of mulberry leaves, and that mulberry varieties with high PECS are generally rated high quality. The usefulness of the parameter has been studied and the mulberry varieties

with high PECS are generally rated as high quality ones [2–4]. It was also concluded that mulberry varieties containing higher contents of nitrogen in leaves have higher PECS. This indicates that nutritive values of mulberry leaves depend on nitrogen content in general and on amount of amino acids in particular. In breeding programmes of mulberry varieties, it is recommended therefore that high contents of nitrogen in leaves be adequately taken into account in selecting varieties nutritive for silkworms [4]. However, so far no study was undertaken to find out the nutritive values of Indian mulberry varieties. Therefore, the present study was carried out to evaluate the nutritional value of different mulberry varieties of India by using the production efficiency of cocoon shell as index by feeding on the popular polyvoltine hybrid, Pure Mysore (PM) × CSR2.

## 2. Materials and Methods

Eleven mulberry varieties the, details of which are depicted in Table 1, were evaluated by feeding on the popular polyvoltine hybrid, Pure Mysore × CSR2. Silkworm rearing was conducted on all these varieties by following the standard rearing

TABLE 1: Results of silkworm rearing utilizing mulberry leaf of different genotypes by polyvoltine hybrid.

Genotype	5th instar larval duration (h)	Amount of food ingested (g)	Amount of food digested (g)	Digestibility (%)	Cocoon weight (g)	Cocoon shell wt (g)	Cocoon shell percentage (%)	Efficiency of cocoon production (ECP)	Production efficiency of cocoon shell (PECS)
V-1	156	2.905	1.215	41.82	1.793	0.351	19.6	1.476	12.08
V-2	164	3.928	1.198	30.49	1.890	0.294	15.6	1.578	7.48
V-3	170	3.095	1.103	35.63	1.538	0.283	18.4	1.394	9.14
V-4	170	2.987	1.177	39.40	1.739	0.328	18.9	1.477	10.98
G-9	170	4.961	1.571	31.66	1.738	0.283	16.3	1.106	5.70
G-3	170	3.970	1.310	32.99	1.645	0.295	17.9	1.256	7.43
S-13	180	3.908	1.468	37.56	1.785	0.316	19.2	1.121	8.09
S-34	170	3.406	1.186	34.82	1.629	0.277	15.5	1.505	8.13
S-36	170	3.017	1.117	37.02	1.476	0.241	14.8	1.458	7.99
S-54	168	3.232	1.122	34.71	1.587	0.270	18.3	1.316	8.35
K-2	168	0.017	1.087	36.05	1.680	0.310	19.5	1.460	10.28
C.D. at 5%	8.53	0.87	0.65	1.33	0.12	0.021	0.71	0.12	2.13

procedure. The fresh weight of the larvae was recorded at the beginning of the fifth instar. The dry weight of each larva was estimated by using the mean percentage of dry matter of an aliquot of like larvae which had been killed by freezing for a short time and then dried at 100°C to a constant weight as per method described by [5]. At the end of the larval period, that is, just before mounting, the dry weight of larvae was determined by following the procedure described earlier. The difference between the final dry weight of the larva and the estimated initial dry weight and of food consumed or digested in relation to increase in body weight is the measure of efficiency of utilization. Data were recorded in respect of cocoon weight, cocoon shell weight, and cocoon shell percentage. ECP and PECS were calculated simultaneously and compared among the varieties. The PECS was calculated as follows

$$\begin{aligned}
 \text{PECS} &= \frac{\text{Cocoon weight}}{\text{Amount of food ingested}} \\
 &= \frac{\text{Amount of food digested}}{\text{Amount of food ingested}} \\
 &\quad \times \frac{\text{Cocoon weight}}{\text{Amount of food digested}} \\
 &= \frac{\text{Cocoon shell weight}}{\text{Cocoon weight}} = D \times \text{ECP} \times \text{PCSW},
 \end{aligned} \tag{1}$$

Where,  $D$  = Digestibility, ECP = Efficiency of cocoon production, PCSW = percentage of cocoon shell weight. The nitrogen content in the leaves of all the 11 mulberry varieties was estimated using Kjeltex system (Tecator).

### 3. Results

The results on the comparison of the utilization of different mulberry varieties (Table 1) indicated that all the characters vary among the different mulberry varieties. The 5th instar larval period ranged from 156 to 180 hr with the highest of 180 hr recorded for S-13 and the lowest of 156 hr recorded for V-1. The amount of food ingested ranged from 0.017 to 4.961 g with the highest of 4.961 g recorded for G-9 and the lowest of 0.017 g recorded for K-2. The amount of food digested ranged from 1.087 to 1.571 g with the highest of 1.571 g recorded for G-9 and the lowest of 1.087 g recorded for K-2. The digestibility ranged from 30.49 to 41.82% with highest of 41.82% recorded for V-1 and the lowest of 30.49% recorded for V-2.

The cocoon weight ranged from 1.476 to 1.890 g with the highest of 1.890 g recorded for V-2 and the lowest of 1.476 g recorded for S-36. The cocoon shell weight ranged from 0.241 to 0.351 g with the highest of 0.351 g recorded for V-1 and the lowest of 0.241 g recorded for S-36. The cocoon shell percentage ranged from 14.79 to 19.58% with the highest of 19.58% recorded for V-1 and the lowest of 14.79% recorded for S-36.

The efficiency of cocoon production ranged from 1.106 to 1.578 with the highest of 1.578 recorded for V-2 and the lowest of 1.106 recorded for G-9. The production efficiency of cocoon shell ranged from 5.70 to 12.08 with the highest of 12.08 recorded for V-1 and the lowest of 5.70 recorded for G-9.

Figure 1 shows correlation between nitrogen contents and PECS indicating that the correlation is 0.74. From the above results, it may be concluded that mulberry varieties containing higher contents of nitrogen in leaves have higher

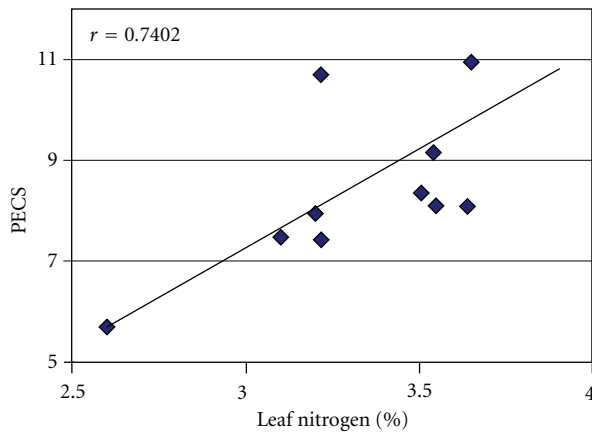


FIGURE 1: Correlation between PECS and leaf nitrogen.

PECS. This indicates that nutritive value of mulberry leaves depend on nitrogen content. In breeding programmes of mulberry varieties, it is recommended therefore that high contents of nitrogen in leaves be adequately taken into account for selecting materials nutritive for silkworms.

#### 4. Discussion

From the rearing data, it becomes very difficult to isolate a profitable mulberry variety fit for silkworm rearing as the differences were very small for all the characters studied. In such cases, the PECS can be used conveniently to evaluate the superior mulberry varieties as the differences in the varieties with respect of PECS are quite high. High PECS is also indicative of less consumption of leaves with excellent rearing performance. PECS showed high and significant correlation with cocoon shell weight and ECP and significant negative correlation with the amount of food ingested and that digested. It has already been stated that the efficiently converted varieties may be consumed less to support the optimal growth. Therefore, varieties possessing high PECS will have better convertibility and so intake of such varieties by the silkworm is low. This appears to be very significant point that silkworms consume less mulberry from the varieties having high PECS and produce higher cocoon yield. References [6, 7] concluded that the high PECS may be treated as the final indicator for the evaluation of nutritive value of mulberry leaves. In the present study, it was also observed that the V-1 variety with high PECS and nitrogen content was more suitable for rearing and hence PECS can be considered as a final indicator for the nutritive value of mulberry leaves.

The differences among the mulberry varieties used in the experiment in respect of digestibility were very small. This is probably due to the fact that all the mulberry varieties used in the experiment are high yielders. But the efficiencies of cocoon production and cocoon shell production varied largely among the varieties. The reduced larval period in the fifth age along with the low intake of food in V-1 clearly indicates that the varieties with high conversion efficiencies

may reduce the larval span and consequently less quantity of the food is needed to support optimal growth which corroborates with the earlier findings of [7, 8].

High PECS is also indicative of less consumption of leaves with excellent rearing performance. PECS showed high and significant correlation with cocoon shell weight and ECP and significant negative correlation with the amount of food ingested and that of digested. It has already been stated that the efficiently converted varieties may consume less mulberry leaves to support the optimal growth. Therefore, varieties possessing high PECS will have better convertibility and so intake of such varieties by the silkworm is low. This appears to be very significant point that silkworms consume less mulberry from the varieties having high PECS and produce higher cocoon yield. Reference [7] in concluded that the high PECS may be treated as the final indicator for the evaluation of nutritive value of mulberry leaves. In the present study, it was also observed that the V-1 variety with high PECS and nitrogen content was more suitable for rearing and hence PECS can be considered as a final indicator for the nutritive value of mulberry leaves.

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